PVsyst - Simulation report

Grid-Connected System

Project: Bank Albilad-Parking

Variant: Bank Albilad tower

No 3D scene defined, no shadings

System power: 51.0 kWp

Al Mu'tamarāt - Saudi Arabia

Author

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VC3, Simulation date:
11/13/24 23:19
with V7.4.8

Project summary

Geographical Site
Al Mu'tamarāt
Saudi Arabia

Weather data
Al Mu'tamarāt
Meteonorm 8.1 (1998-2002), Sat=28% - Synthetic

Situation
Latitude	24.68 °N
Longitude	46.69 °E
Altitude	602 m
Time zone	UTC+3

Project settings
Albedo	0.20

System summary

Grid-Connected System
Simulation for year no 1

No 3D scene defined, no shadings

PV Field Orientation
Fixed planes	2 orientations	
Tilts/azimuths	5 / 62 °	
	5 / 29 °	

Near Shadings
No Shadings

User's needs
Unlimited load (grid)

System information

PV Array
Nb. of modules	85 units
Pnom total	51.0 kWp

Inverters
Nb. of units	1 unit
Pnom total	40.0 kWac
Pnom ratio	1.275

Results summary

Produced Energy	97057 kWh/year	Specific production	1903 kWh/kWp/year	Perf. Ratio PR	82.90 %

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General parameters

Grid-Connected System   **No 3D scene defined, no shadings**

PV Field Orientation

Orientation		Sheds configuration	Models used	
Fixed planes	2 orientations	No 3D scene defined	Transposition	Perez
Tilts/azimuths	5 / 62 °		Diffuse	Perez, Meteonorm
	5 / 29 °		Circumsolar	separate

Horizon	**Near Shadings**	**User's needs**
Free Horizon	No Shadings	Unlimited load (grid)

PV Array Characteristics

PV module		**Inverter**	
Manufacturer	Astronergy	Manufacturer	Huawei Technologies
Model	CHSM66RN(DG)F-BH-600	Model	SUN2000-40KTL-M3-400V
(Custom parameters definition)		(Original PVsyst database)	
Unit Nom. Power	600 Wp	Unit Nom. Power	40.0 kWac
Number of PV modules	85 units	Number of inverters	1 unit
Nominal (STC)	51.0 kWp	Total power	40.0 kWac

Array #1 - PV Array			
Orientation	#1		
Tilt/Azimuth	5/62 °		
Number of PV modules	30 units	Number of inverters	1 * MPPT 41% 0.4 unit
Nominal (STC)	18.00 kWp	Total power	16.4 kWac
Modules	2 string x 15 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	16.77 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	557 V	Pnom ratio (DC:AC)	1.10
I mpp	30 A		

Array #2 - Sub-array #2			
Orientation	#1		
Tilt/Azimuth	5/62 °		
Number of PV modules	14 units	Number of inverters	1 * MPPT 15% 0.1 unit
Nominal (STC)	8.40 kWp	Total power	6.0 kWac
Modules	1 strings x 14 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	7.82 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	520 V	Pnom ratio (DC:AC)	1.40
I mpp	15 A		

Array #3 - Sub-array #3			
Orientation	#2		
Tilt/Azimuth	5/29 °		
Number of PV modules	26 units	Number of inverters	1 * MPPT 28% 0.3 unit
Nominal (STC)	15.60 kWp	Total power	11.1 kWac
Modules	2 string x 13 In series		
At operating cond. (50°C)		Operating voltage	200-1000 V
Pmpp	14.53 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	483 V	Pnom ratio (DC:AC)	1.40
I mpp	30 A		

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PV Array Characteristics

Array #4 - Sub-array #4

Orientation	#2			
Tilt/Azimuth	5/29 °			
Number of PV modules	15 units	Number of inverters	1 * MPPT 16%	0.2 unit
Nominal (STC)	9.00 kWp	Total power		6.4 kWac
Modules	1 strings x 15 In series			

At operating cond. (50°C)

		Operating voltage	200-1000 V
Pmpp	8.38 kWp	Max. power (=>40°C)	44.0 kWac
U mpp	557 V	Pnom ratio (DC:AC)	1.40
I mpp	15 A		

Total PV power

Nominal (STC)	51 kWp	**Total inverter power**	
		Total power	40 kWac
Total	85 modules	Number of inverters	1 unit
Module area	230 m²	Pnom ratio	1.27
		Power sharing defined	

Array losses

Array Soiling Losses

Loss Fraction	4.0 %

Thermal Loss factor

Module temperature according to irradiance

Uc (const)	29.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

LID - Light Induced Degradation

Loss Fraction	0.6 %

Module Quality Loss

Loss Fraction	0.0 %

Module average degradation

Year no	1
Loss factor	0.4 %/year

Mismatch due to degradation

Imp RMS dispersion	0.4 %/year
Vmp RMS dispersion	0.4 %/year

Module mismatch losses

Array #1 - PV Array

Loss Fraction	1.0 % at MPP

Array #2 - Sub-array #2

Loss Fraction	1.0 % at MPP

Array #3 - Sub-array #3

Loss Fraction	1.0 % at MPP

Array #4 - Sub-array #4

Loss Fraction	1.0 % at MPP

IAM loss factor

Incidence effect (IAM): User defined profile

0°	40°	50°	60°	70°	75°	80°	85°	90°
1.000	1.000	1.000	1.000	1.000	0.984	0.949	0.830	0.000

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DC wiring losses

Global wiring resistance	10 mΩ
Loss Fraction	1.0 % at STC

Array #1 - PV Array		**Array #2 - Sub-array #2**	
Global array res.	201 mΩ	Global array res.	375 mΩ
Loss Fraction	1.0 % at STC	Loss Fraction	1.0 % at STC
Array #3 - Sub-array #3		**Array #4 - Sub-array #4**	
Global array res.	174 mΩ	Global array res.	402 mΩ
Loss Fraction	1.0 % at STC	Loss Fraction	1.0 % at STC

System losses

Unavailability of the system

Time fraction	2.0 %
	7.3 days,
	3 periods

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Main results

System Production

Produced Energy	97057 kWh/year	Specific production	1903 kWh/kWp/year
		Perf. Ratio PR	82.90 %

Normalized productions (per installed kWp)

Lc: Collection Loss (PV-array losses)   0.84 kWh/kWp/day
Ls: System Loss (inverter, ...)   0.23 kWh/kWp/day
Yf: Produced useful energy (inverter output)   5.21 kWh/kWp/day

Performance Ratio PR

PR: Performance Ratio (Yf / Yr) : 0.829
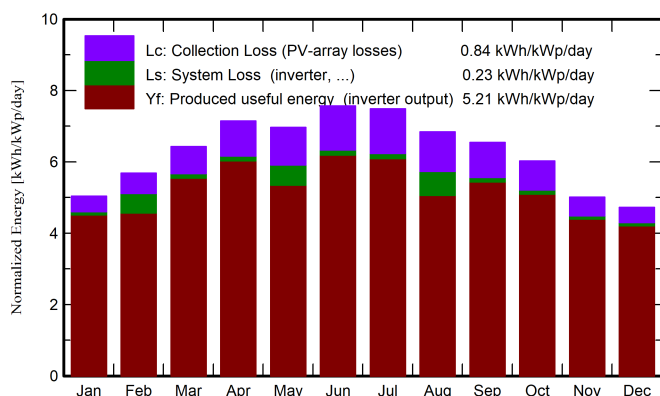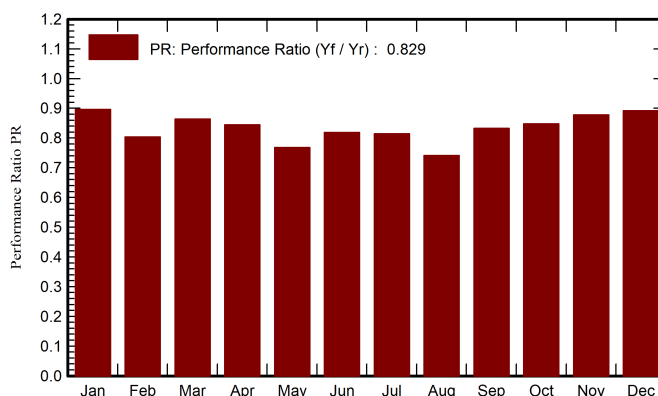
Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	kWh	kWh	ratio
January	147.0	26.14	14.73	156.2	149.6	7288	7144	0.897
February	153.0	50.40	18.07	159.1	152.5	7310	6526	0.804
March	194.2	63.21	22.88	199.2	191.0	8972	8778	0.864
April	211.9	77.10	27.71	214.3	205.3	9432	9225	0.844
May	216.1	88.68	34.20	216.1	207.1	9354	8460	0.768
June	227.9	91.31	36.27	227.0	217.6	9700	9481	0.819
July	232.7	82.07	37.84	232.1	222.6	9864	9642	0.814
August	210.9	87.33	37.99	212.0	203.1	9072	8010	0.741
September	192.8	61.77	34.13	196.2	188.0	8519	8331	0.832
October	179.8	42.06	29.52	186.6	178.8	8249	8070	0.848
November	141.8	35.35	21.33	150.3	144.0	6866	6726	0.878
December	136.8	26.83	16.58	146.4	140.2	6798	6664	0.892
Year	2245.0	732.25	27.66	2295.7	2200.0	101424	97057	0.829

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

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Loss diagram
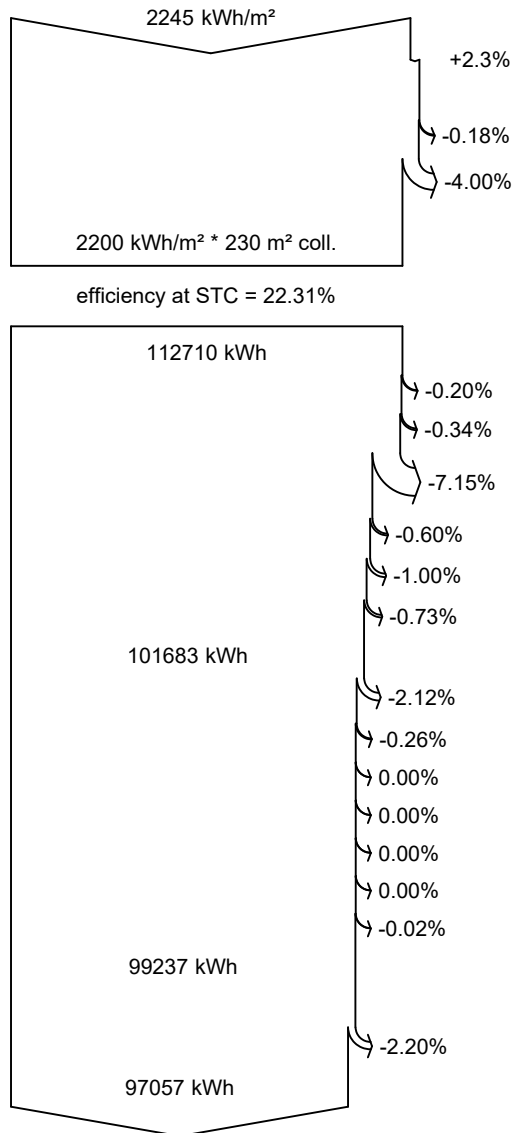
Value	Loss	Label
2245 kWh/m²		**Global horizontal irradiation**
	+2.3%	**Global incident in coll. plane**
	-0.18%	IAM factor on global
	-4.00%	Soiling loss factor
2200 kWh/m² * 230 m² coll.		**Effective irradiation on collectors**
efficiency at STC = 22.31%		PV conversion
112710 kWh		**Array nominal energy (at STC effic.)**
	-0.20%	Module Degradation Loss (for year #1)
	-0.34%	PV loss due to irradiance level
	-7.15%	PV loss due to temperature
	-0.60%	LID - Light induced degradation
	-1.00%	Mismatch loss, modules and strings
	-0.73%	Ohmic wiring loss
101683 kWh		**Array virtual energy at MPP**
	-2.12%	Inverter Loss during operation (efficiency)
	-0.26%	Inverter Loss over nominal inv. power
	0.00%	Inverter Loss due to max. input current
	0.00%	Inverter Loss over nominal inv. voltage
	0.00%	Inverter Loss due to power threshold
	0.00%	Inverter Loss due to voltage threshold
	-0.02%	Night consumption
99237 kWh		**Available Energy at Inverter Output**
	-2.20%	System unavailability
97057 kWh		**Energy injected into grid**

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Predef. graphs

Daily Input/Output diagram

Values from 01/01 to 12/31
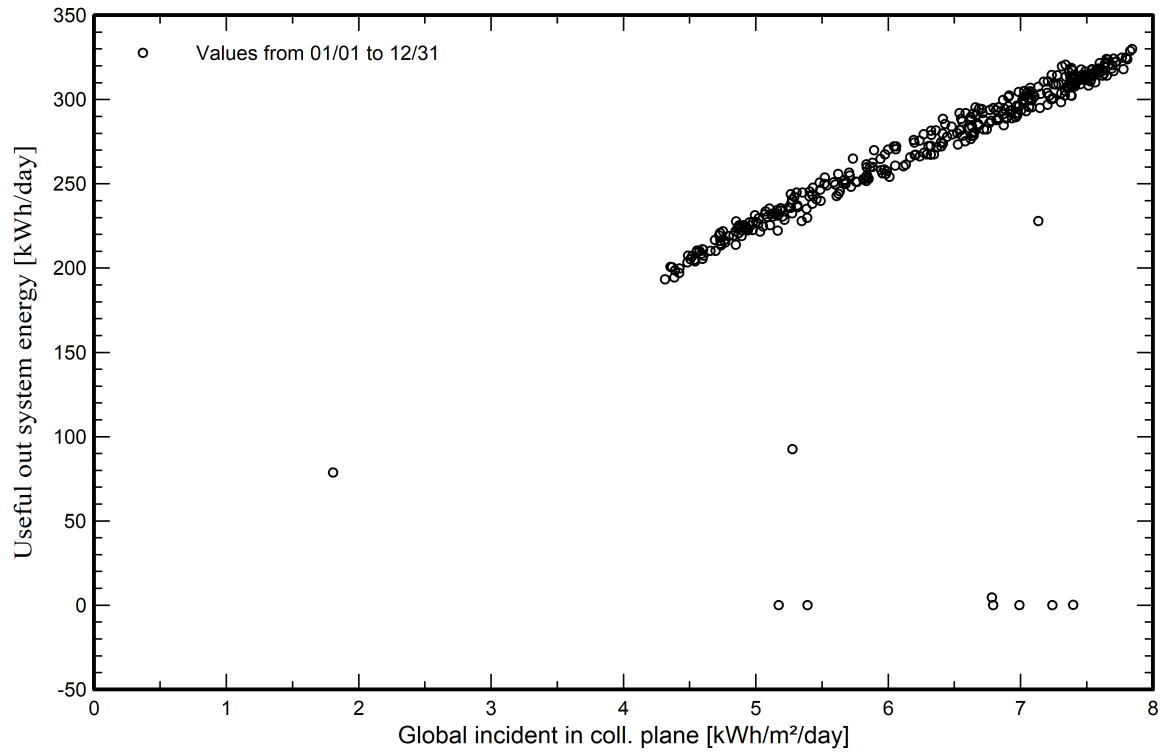
System Output Power Distribution

Values from 01/01 to 12/31

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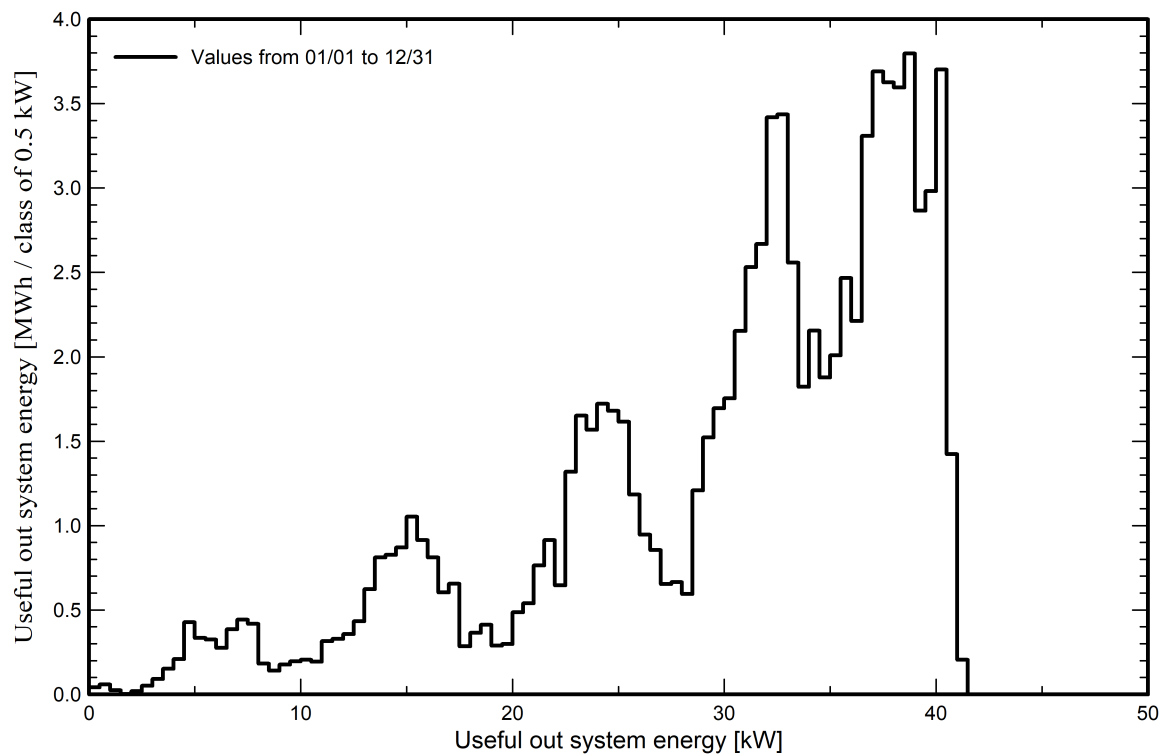
P50 - P90 evaluation

Weather data

Source	Meteonorm 8.1 (1998-2002), Sat=28%	
Kind	TMY, multi-year	
Year-to-year variability(Variance)		3.0 %

Specified Deviation

Climate change	0.0 %

Global variability (weather data + system)

Variability (Quadratic sum)	3.5 %

Simulation and parameters uncertainties

PV module modelling/parameters	1.0 %
Inverter efficiency uncertainty	0.5 %
Soiling and mismatch uncertainties	1.0 %
Degradation uncertainty	1.0 %

Annual production probability

Variability	3.40 MWh
P50	97.06 MWh
P90	92.70 MWh
P95	91.48 MWh

Probability distribution
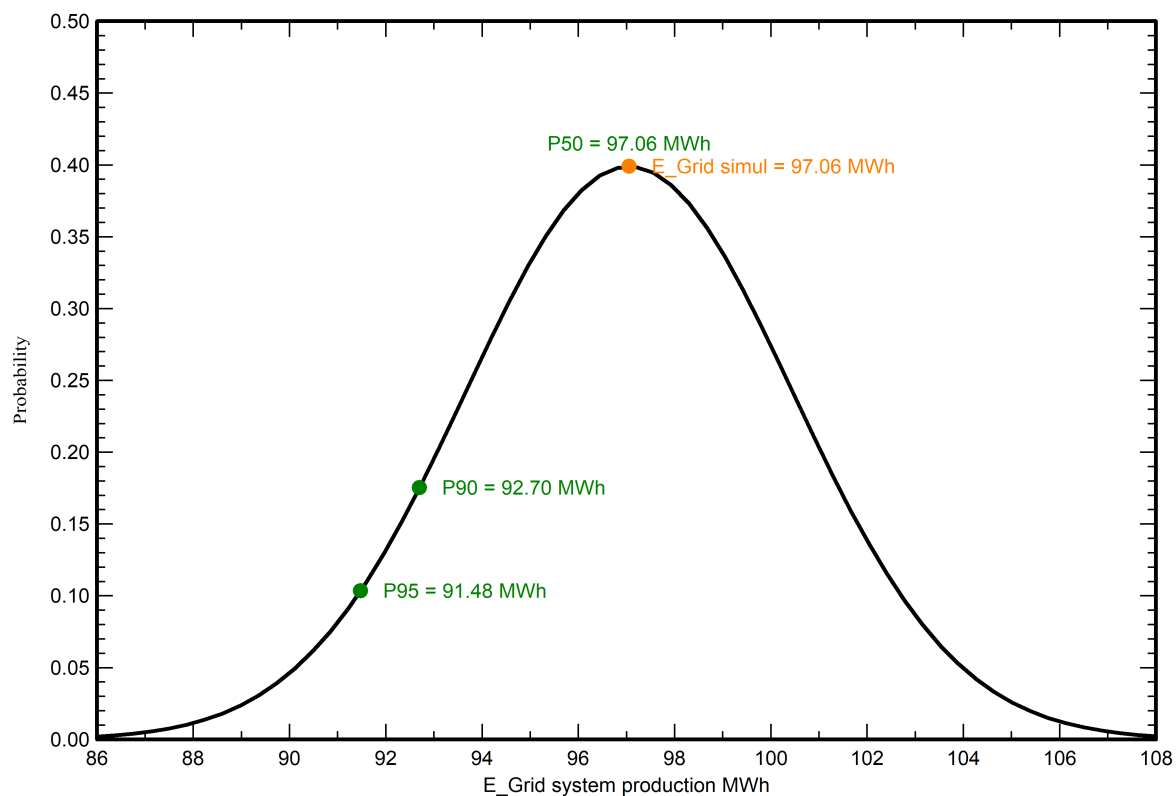
P50 = 97.06 MWh
E_Grid simul = 97.06 MWh
P90 = 92.70 MWh
P95 = 91.48 MWh

Single-line diagram

15 x CHSM66RN(DG)F-BH-600
2 Strings

14 x CHSM66RN(DG)F-BH-600

13 x CHSM66RN(DG)F-BH-600
2 Strings

15 x CHSM66RN(DG)F-BH-600

DC/AC
(40 kVA)
(4 MPPT)

kWh
Injection point
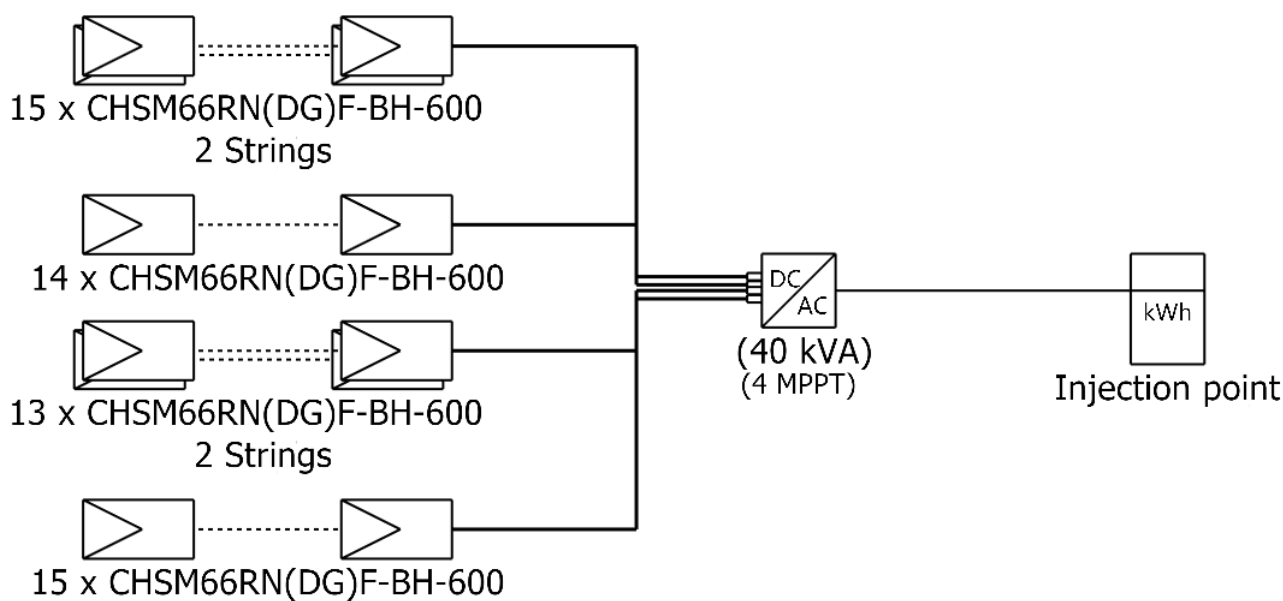
PV module	CHSM66RN(DG)F-BH-600
Inverter	SUN2000-40KTL-M3-400V
String 1	15 x CHSM66RN(DG)F-BH-600
String 2	14 x CHSM66RN(DG)F-BH-600
String 3	13 x CHSM66RN(DG)F-BH-600

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